GEOLOGIC CHARACTERIZATION OF LAKE HARRIS

LAKE COUNTY, FLORIDA

By

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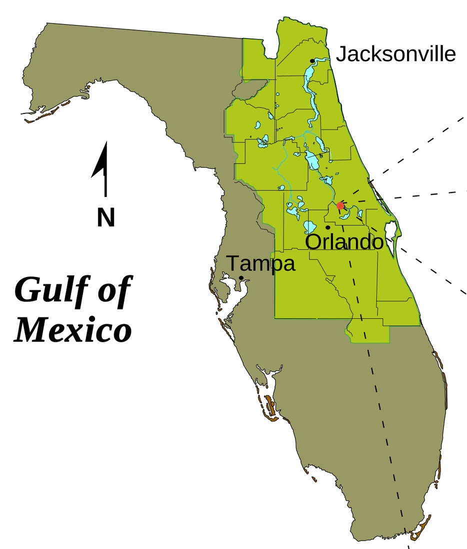
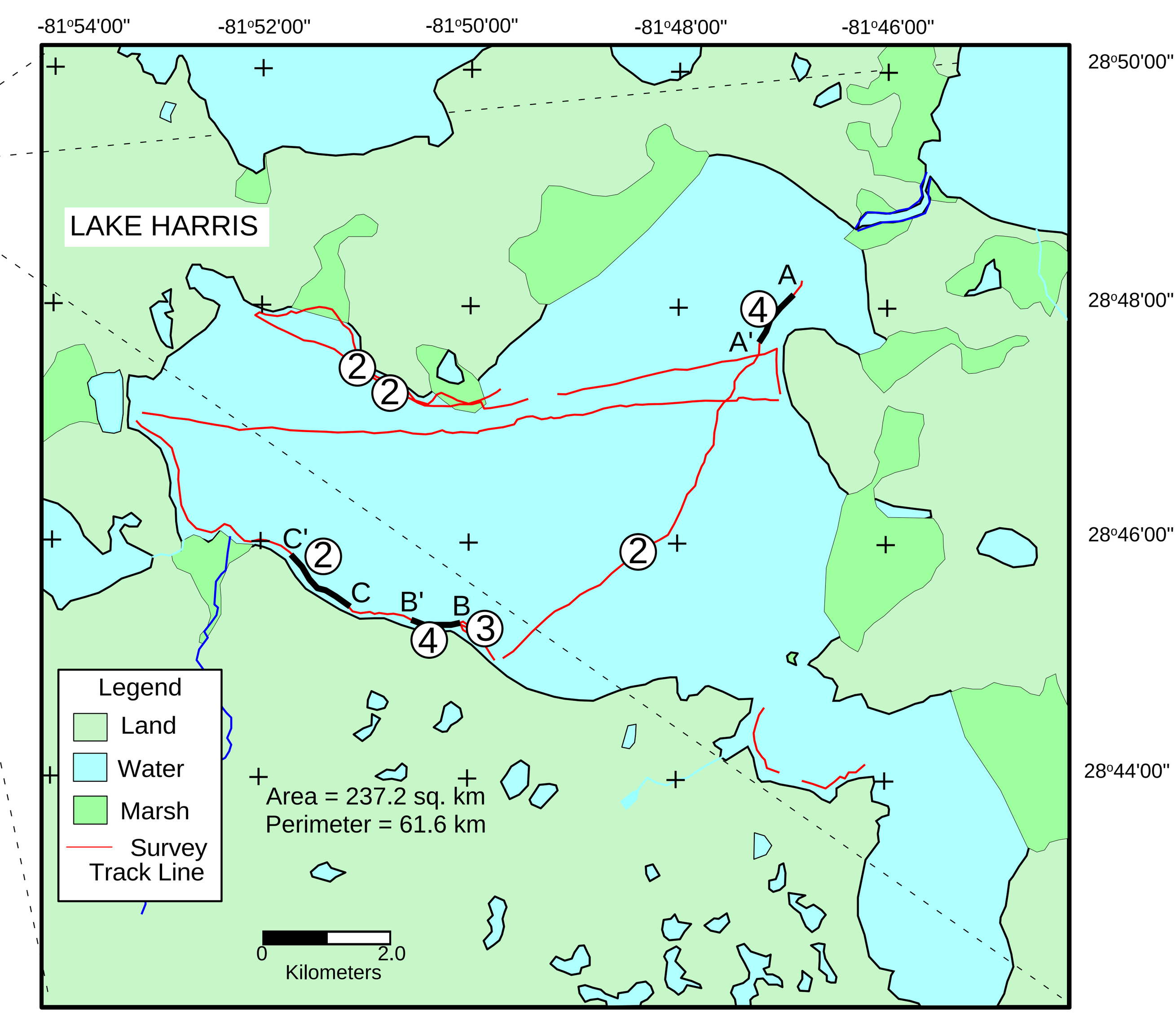
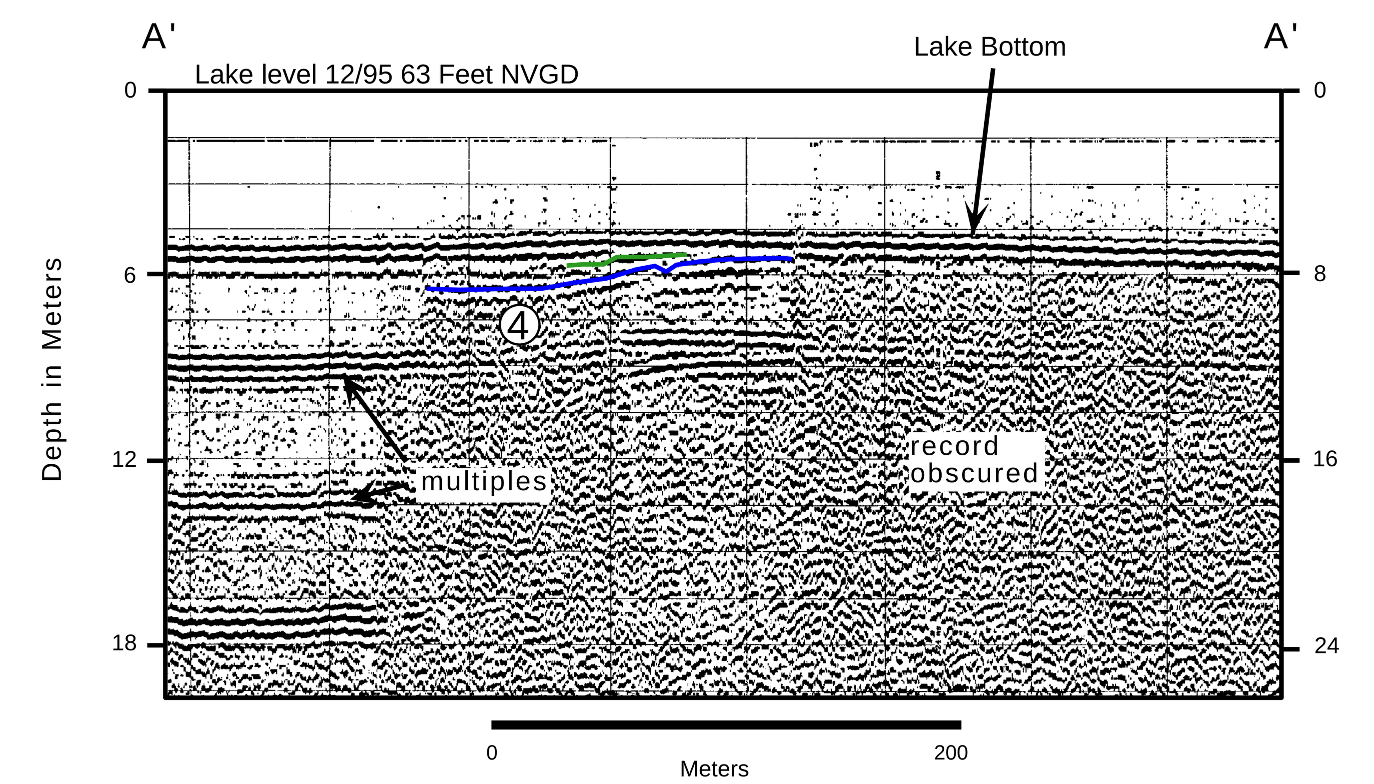
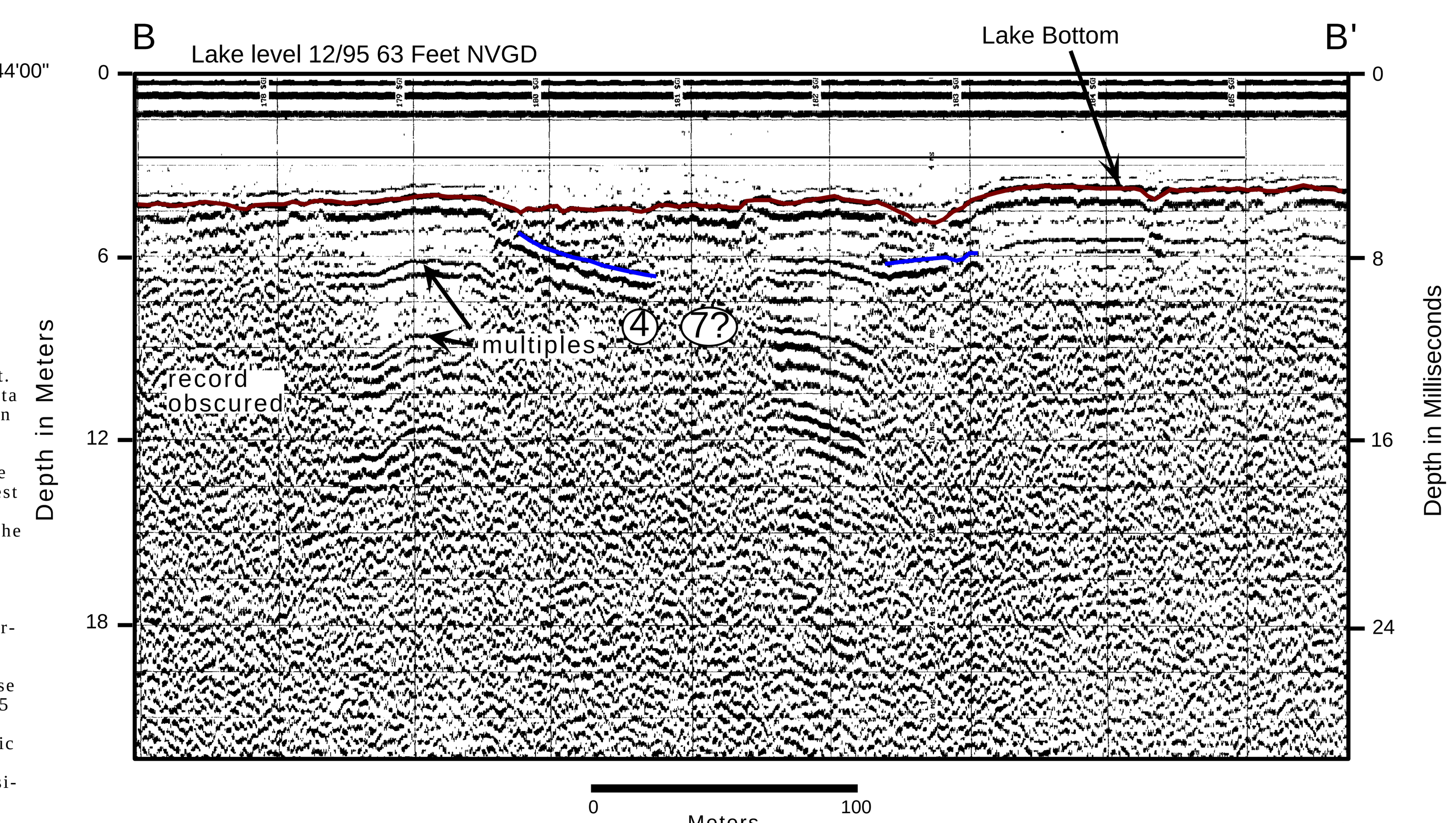
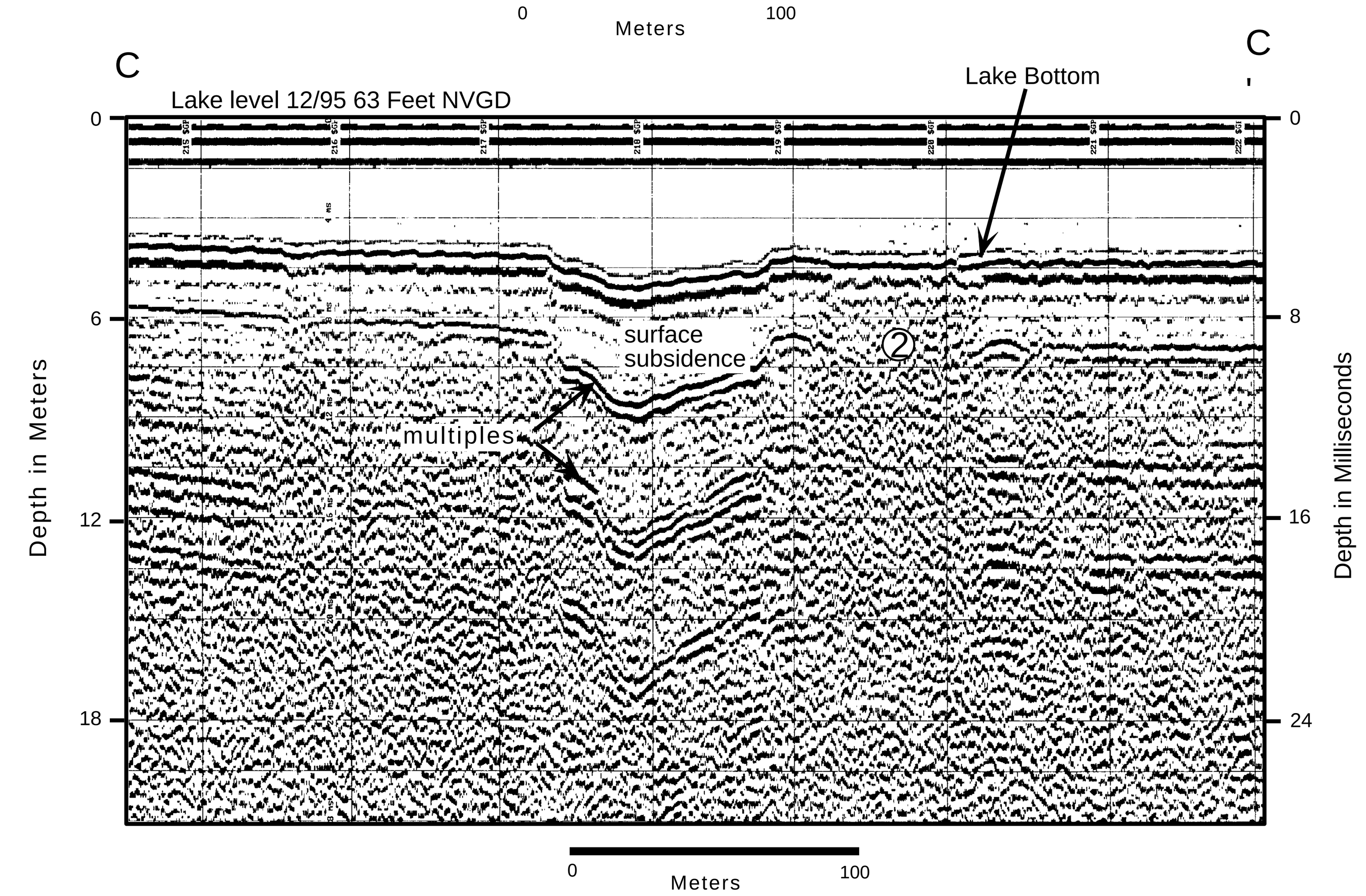


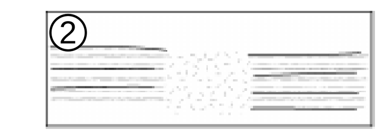




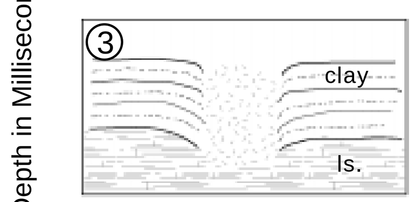




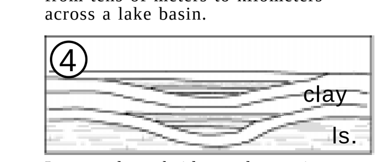
EXPLANATION



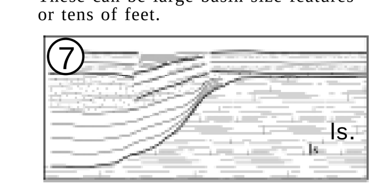
Undisturbed section with areas obscured by noise created by muck or aquatic vegetation dispersing the acoustic signal.



Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



Low angle, subsidence depressions. Parallel reflectors are relatively intact. Horizontal reflectors onlap onto the subsided parallel reflectors and represent deposition during subsidence. These can be large basin size features or tens of feet.



Mid- to high-angle parallel reflectors with indications of vertical displacement and rotation. Feature may be buried by overburden. Represents blocks from the sides of collapse sinks that have slumped into the sink.

INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling-equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Forty-four line-km of HRSP data was collected from Lake Disston. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

Physiography

Lake Harris is part of a chain of lakes that comprise the Central Lakes region of the Central Lakes District. The county name, Lake, further attests to the predominance of the water-table lakes in this area. The district is characterised as sand hill karst with solution basins (Brooks,). In this area the Hawthorn Group pinches out onto the Ocala Group as the latter uplifts to the west. Lake Harris has an irregular shape, covering 73 square kilometers with about 62 kilometers of shoreline. The lake narrows to Little Lake Harris to the south and Lake Denham to the west. Dead River joins the lake with Lake Eustis to the northeast. Sand hills with numerous small lakes within their intersticies trend southeastward from the southern shore.

GEOLOGIC CHARACTERIZATION

Multiples persist in the seismic profiles throughout the central portions of the lake. This is characteristic in lakes where the bottom sediments are hard sands or rock. Scott, 1988, estimates the top of the Hawthorn Group to be greater than 50 feet above mean sea level in a nearby core. Lake level at the time of the survey was 63 feet NVGD. This would suggest that the lakes that occupy the interstices of the sand hills in this area are floored within the Hawthorn Group, which contains phosphatic sands, calcite and dolomites. In a couple of places the acoustic return is obscured by noise, or 'gassed out' (profile C-C', features map). This could indicate an accumulation of organic material in the bottom sediments which acts to disperse the signal. Profiles A-A' and B-B' show areas where a reflective horizon can be seen dipping away from the surface. Associated with this is a subsidence in the lake bottom. The feature resembles that of a Type 4 feature as described in the explanation to the right, although little or no infilling is visible in the record. Another possibility is that the dipping horizon could represent a down-faulted or rotated block that is subsiding into a large collapse structure at depth, similar to a Type 7 feature. However, multiples and noise obscure the record so that if any deeper, influencing structures are present they are not visible. Profile C-C' is an examples of small scale lake bottom subsidences within the lake. No influencing features below the subsidences can be seen because of the persistent multiples, although dissolution within members of the Hawthorn Group is probably occuring. The subsidences are similar in size to the numerous small sinks visible to the south of the lake and trending to the northwest. It is possible that the lake bottom subsidences represent a lakeward extension of this karst trend.

Index of features noted on seismic profiles